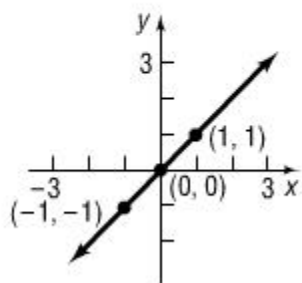


## Library of Functions; Piecewise-Defined Functions

**Identity Function**

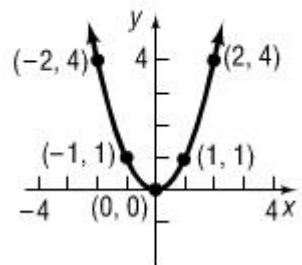
$$f(x) = x$$



- Domain:  $\mathbb{R}$
- Range:  $\mathbb{R}$
- Line with slope of  $m = 1$
- Intercept:  $(0,0)$
- Odd Function
- Increasing on  $(-\infty, \infty)$
- Bisects Quadrants I and III
- Key Points:  $(-2,-2)$ ,  $(-1,-1)$ ,  $(0,0)$ ,  $(1,1)$ ,  $(2,2)$

**Square Function**

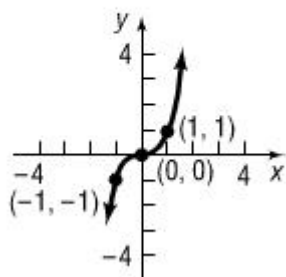
$$f(x) = x^2$$



- Domain:  $\mathbb{R}$
- Range:  $[0, \infty)$
- Parabola
- Intercept:  $(0,0)$
- Even Function
- Decreasing on  $(-\infty, 0)$  and increasing on  $(0, \infty)$
- Key Points:  $(-2,4)$ ,  $(-1,1)$ ,  $(0,0)$ ,  $(1,1)$ ,  $(2,4)$

**Cube Function**

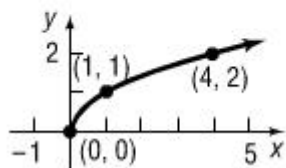
$$f(x) = x^3$$



- Domain:  $\mathbb{R}$
- Range:  $\mathbb{R}$
- Intercept:  $(0,0)$
- Odd Function
- Increasing on  $(-\infty, \infty)$
- Key Points:  $(-2,-8)$ ,  $(-1,-1)$ ,  $(0,0)$ ,  $(1,1)$ ,  $(2,8)$

**Square Root Function**

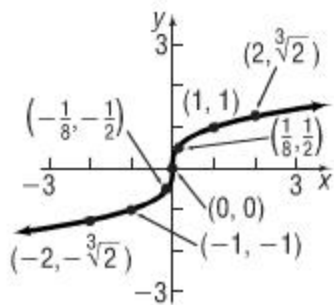
$$f(x) = \sqrt{x}$$



- Domain:  $[0, \infty)$
- Range:  $[0, \infty)$
- Intercept:  $(0,0)$
- Neither even nor odd
- Increasing on  $[0, \infty)$
- Minimum value of 0 at  $x = 0$
- Key Points:  $(0,0)$ ,  $(1,1)$ ,  $(4,2)$ ,  $(9,3)$

## Cube Root Function

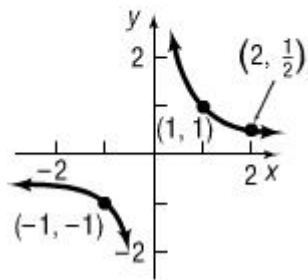
$$f(x) = \sqrt[3]{x}$$



- Domain:  $\mathbb{R}$
- Range:  $\mathbb{R}$
- Intercept:  $(0,0)$
- Odd Function
- Increasing on  $(-\infty, \infty)$
- Key Points:  $(-8, -2)$ ,  $(-1, -1)$ ,  $(0,0)$ ,  $(1,1)$ ,  $(8,2)$

## Reciprocal Function

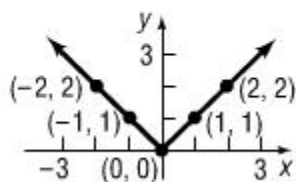
$$f(x) = \frac{1}{x}$$



- Domain:  $(-\infty, 0) \cup (0, \infty)$
- Range:  $(-\infty, 0) \cup (0, \infty)$
- No Intercepts
- Odd Function
- Decreasing on  $(-\infty, 0)$  and  $(0, \infty)$
- Key Points:  $(-2, -\frac{1}{2})$ ,  $(-1, -1)$ ,  $(-\frac{1}{2}, -2)$ ,  $(\frac{1}{2}, 2)$ ,  $(1, 1)$ ,  $(2, \frac{1}{2})$

## Absolute Value Function

$$f(x) = |x|$$



- Domain:  $\mathbb{R}$
- Range:  $[0, \infty)$
- Intercept:  $(0,0)$
- Even Function
- Decreasing on  $(-\infty, 0)$  and increasing on  $(0, \infty)$
- Minimum value of 0 at  $x = 0$
- Key Points:  $(-2,2)$ ,  $(-1,1)$ ,  $(0,0)$ ,  $(1,1)$ ,  $(2,2)$

## Graphing Piecewise-Defined Functions

Sometimes a function is defined differently on different parts of its domain. When functions are defined by more than one equation, they are called *piecewise-defined functions*.

**Examples:** For the following functions:

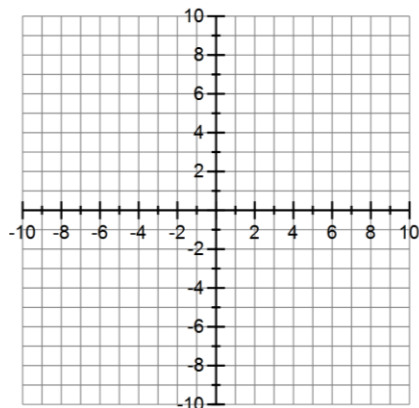
a) Graph the function.

c) Locate any intercepts.

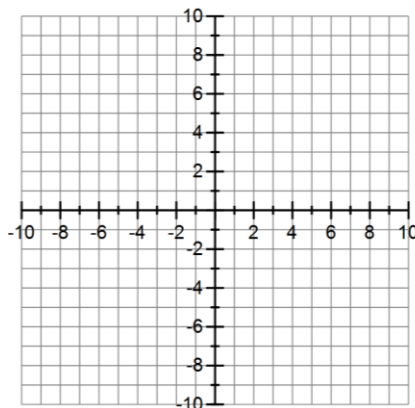
b) Find the domain and range of the function.

d) State whether the function is continuous on its domain.

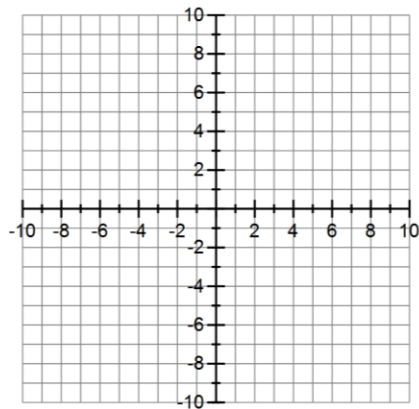
1)  $f(x) = \begin{cases} x+3 & \text{if } x \leq -1 \\ 2x & \text{if } x > -1 \end{cases}$



2)  $f(x) = \begin{cases} 2 & \text{if } -4 < x < 0 \\ x^2 + 2 & \text{if } x \geq 0 \end{cases}$



3)  $f(x) = \begin{cases} 3-x & \text{if } -5 \leq x < -2 \\ \sqrt{x} & \text{if } 0 < x < 4 \\ 2x-6 & \text{if } x \geq 4 \end{cases}$



4)  $f(x) = \begin{cases} |x| & \text{if } x < 2 \\ 5 & \text{if } x = 2 \\ -\frac{1}{2}x & \text{if } x > 2 \end{cases}$

